

CLAIMS

- 5 1. A substrate, suitable for the preparation of a composite membrane, which substrate comprises a porous matrix of fibres, characterised in that the fibres comprise mixed amorphous silica fibres that are bound with a binder.
2. A substrate according to claim 1, wherein the mixed amorphous silica fibres comprise micro-fine amorphous silica fibres.
- 10 3. A substrate according to claim 1 or claim 2, wherein the mixed amorphous silica fibres comprise one or more chopped strand(s) of amorphous silica.
- 15 4. A substrate according to any preceding claim wherein the amorphous silica fibres comprise a mixture of both microfibrils and chopped fibres in the range of from 95:5% to 5:95% by weight of the mixture respectively.
- 20 5. A substrate according to claim 4 wherein the amorphous silica fibres comprise a mixture of both microfibrils and chopped fibres in the range of from 70:30% to 30:70% by weight of the mixture respectively.
6. A substrate according to any preceding claim wherein the fibres have a diameter in the range of from 0.1 μ m to 50 μ m.
- 25 7. A substrate according to claim 6 wherein the fibres have a diameter in the range of from 0.4 μ m to 9 μ m.
8. A substrate according to any preceding claim, wherein the binder comprises a solution or dispersion of ion-exchange polymeric materials, or non-ion-conducting polymers, or inorganic materials or mixtures thereof.
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9. A substrate according to any preceding claim for use in the preparation of a composite membrane.

5 10. A composite membrane comprising a porous substrate of fibres and at least one ion-conducting polymer, characterised in that the substrate is one according to any preceding claim, which comprises mixed amorphous silica fibres bound with a binder.

10 11. A composite membrane according to claim 10, which when tested by the method described herein in the Examples, results in less than or equal to about $\pm 9\%$ change in the area.

12. A composite membrane according to claim 10 or claim 11 wherein the total thickness of the membrane is less than $200\mu\text{m}$.

15 13. A composite membrane according to any one of claims 10 to 12 for use in a fuel cell.

14. A process for the manufacture of a substrate according to any one of claims 1 to 9, which process comprises

- 20 (a) dispersing the fibres in water to form a slurry;
(b) depositing the slurry onto a mesh bed to form a network;
(c) drying and compacting the fibre network; and
(d) applying, before or after step (c), a dispersion of binder.

25 15. A process for the manufacture of a membrane according to any one of claims 10 to 13, which process comprises

- 30 (i) forming a porous substrate of, preferably randomly orientated individual mixed amorphous silica fibres bound with a binder by a process according to claim 14; and, thereafter,
(ii) impregnating the porous substrate with a polymeric material to produce a membrane.

16. A process according to claim 15, wherein step (ii) is carried out by nip roller coating of the substrate to fill it with a solution of ion-conducting polymeric material, and further compaction and drying of the membrane.
- 5 17. A membrane electrode assembly comprising a substrate according to any one of claim 1 to 9 and/or a composite membrane according to any one of claims 10 to 13.
18. A fuel cell comprising a substrate according to any one of claim 1 to 9 and/or a composite membrane according to any one of claims 10 to 13.